Orthopaedics & Traumatology: Surgery & Research 101 (2015) S323–S326

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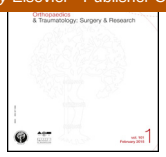

Original article

Meniscal survival rate after anterior cruciate ligament reconstruction

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ARTICLE INFO

Article history:
Received 2 July 2015
Accepted 31 August 2015

Keywords:
Anterior cruciate ligament
Meniscal suture
Normal meniscus
Meniscal survival

ABSTRACT

Background: Meniscal suture provides well-documented benefits. Integrity of the cruciate ligaments of the knee is a prerequisite for meniscal healing. Nevertheless, reconstruction of the anterior cruciate ligament (ACL) does not consistently prevent recurrent tearing of a sutured meniscus. We evaluated meniscal survival rates, 5 and 10 years after meniscal suture concomitant with an ACL reconstruction. We compared the outcomes of these repaired menisci to those in which no menisci tears were detected during ACL reconstruction.

Methods: In this multi-centric retrospective study, we included two groups. One group consists of patients who underwent a meniscal repair. This group was further divided into two subgroups based on whether follow-up was 5 years ($n = 76$) or 10 years ($n = 39$). The control group included 120 patients with normal menisci observed during surgery. We studied meniscal survival rates in each group, and we analyzed risk factors associated with the recurrence of meniscal lesions.

Results: The 5-year meniscal survival rate was significantly higher in the control group than in the meniscal-repair group (95% vs. 80%, respectively; $P = 0.0029$). The controls group also had a higher meniscal survival rate after 10 years, although the difference was not statistically significant (88% vs. 77%, $P = 0.07$). A difference in knee laxity greater than 4 mm was associated with a 5-fold increase in the risk of recurrent meniscal tears ($P = 0.0057$). After 5 years, the risk of recurrence was higher for the medial than for the lateral meniscus, whereas after 10 years the difference was no longer statistically significant.

Discussion: Although insufficient healing after meniscal suturing contributes to the risk of further meniscal tears, new lesions can develop in menisci that were undamaged at the time of ACL reconstruction. The risk of a new meniscal lesion is strongly associated with inadequate control of antero-posterior and rotational laxity. Some apparently "new menisci lesions" seems to have been missed during ACL reconstruction.

Level of evidence: IV, retrospective study.

1. Introduction

Among patients with anterior cruciate ligament (ACL) tears, up to 60% also have meniscal lesions [1]. The management and repair of these meniscal tears in stable or stabilised knees is now well standardised and has been reported to carry a 70 to 80% success rate

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http://dx.doi.org/10.1016/j.otsr.2015.09.005
1877-0568/

Table 1
Epidemiological characteristics in the three groups (the data are mean ± SD or %).

	5-year subgroup	10-year subgroup	*P*	Controls	*P*
Age (years)	26.6 ± 8	30 ± 9.8	0.65	26.7 ± 7.5	0.34
BMI	23.8 ± 3.5	24.2 ± 3.8	0.77	23.7 ± 3.3	0.7
Time to surgery (months)	48.93 ± 99.4	30.1 ± 53.4	0.293	27.3 ± 64	0.114
Laxity difference vs. other knee (mm)	1.78 ± 1.1	3.9 ± 3.3	0.001	1.61 ± 1.3	0.016
Male gender	72%	67.7%	0.629	60.5%	0.102
Right knee involved	43.2%	61.5%	0.056	48.6%	0.491
Reconstruction technique					
KJ	42.3%	62.5%	0.087	48.7%	0.829
RMST	56.4%	35.0%		50.4%	
QT	1.3%	2.5%		0.8%	

Ligament reconstruction techniques: KJ: Kenneth-Jones; RMST: rectus medialis/semi-tendinosus; QT: quadricipital tendon.

[1]. In the absence of surgical stabilisation, the meniscal lesions are unlikely to heal spontaneously. Instead, they usually worsen, and new lesions may develop [2]. In patients who undergo surgical ACL reconstruction, 50% of meniscal lesions may be amenable to repair [3,4].

Surgical knee stabilisation combined with suturing of meniscal tears decreases the risk of progression to osteoarthritis [5,6]. Nevertheless, despite knee stabilisation by ACL reconstruction, about 19% of patients without detected meniscal tear have osteoarthritis after 12 years [5]. The mechanism by which osteoarthritis develops despite a favourable meniscal status at ligament reconstruction is unclear. Inadequate control of antero-posterior and rotational laxity is probably a major adverse factor [7]. A return to sporting activities combined with inadequate stabilisation of the operated knee may explain that meniscal lesions can develop some time after the ligament reconstruction procedure. Few data are available on the frequency of secondary meniscectomy in patients whose menisci were considered normal at ligament reconstruction [8].

The objective of our study was to compare outcomes of healthy and repaired menisci 5 and 10 years after ACL reconstruction.

2. Material and methods

This retrospective multicentre study (4 centres) was conducted in 2013 in preparation for the 2014 symposium held by the French Society for Arthroscopy (Société française d'arthroscopie [SFA]). Patients who had had ACL reconstruction using any technique (patellar tendon, quadricipital tendon, or hamstring tendons) in 2003 or 2008 were included, to obtain two populations with follow-ups of 10 and 5 years, respectively. Based on the surgical reports, the patients were divided into two groups: in one, the medial and/or lateral meniscus was repaired during the same procedure (meniscal repair group) and, in the other, no meniscal lesions were detected during surgery (control group).

The meniscal repair group was further divided into two subgroups depending on whether surgery was performed in 2003 ($n = 39$) or in 2008 ($n = 76$). Follow-up was thus 10 years and 5 years in these two subgroups, respectively. In the 10-year subgroup, mean age was 30 ± 10 years and 67.5% of patients were males; ACL reconstruction was performed using the patellar tendon in 62.5% of patients and the hamstring tendons or quadricipital tendon in the remaining patients. In the 5-year subgroup, mean age was 26.6 ± 8 years and 71.8% of patients were males; the hamstring tendons were used for reconstruction in 56.4% of these patients. The only statistically significant difference between the 10-year and 5-year subgroups was a greater difference in laxity versus the contralateral knee in the 5-year group.

The control group included 120 patients who underwent ACL reconstruction in the same centres and at the same dates. Mean age was 26.6 ± 7.5 years, and 60.5% of controls were males. The patellar tendon was used in 48.6% of cases, the hamstring tendons in 50.4%, and the quadricipital tendon in 0.8%.

No matching was performed between the meniscal repair patients and the controls. Tables 1 and 2 report the other epidemiological data (body mass index and characteristics of the meniscal lesions, i.e., side, size, zone, and number of implants used for repair). The only statistically significant between-group difference was a greater difference in laxity versus the contralateral knee in the meniscal repair group compared to the control group.

The meniscal suturing technique was at the discretion of the surgeon. The meniscal rim was routinely abraded using an electric knife or basket forceps. Suturing was performed by either the all-inside technique with one or more disposable hybrid sutures or the outside-in technique. In each patient, the type of implant used and the number of stitches were recorded.

After 1 year, each patient underwent a clinical evaluation including knee laxity measurements (KT1000, TELOS, or Rolimeter) to assess the effectiveness of the ACL reconstruction procedure. Patients were called by telephone at last follow-up and asked whether they had had further arthroscopic surgery for meniscectomy. If they had, the new surgical report was obtained to determine the status of the meniscus. In the control group, all meniscal lesions were classified as new. In the 5-year and 10-year meniscal repair subgroups, failure of meniscal suturing was defined as a lesion that was identical to the initial lesion (although not necessarily of the same size); in patients with new lesions, defined as lesions in the other meniscus or different lesions in the same meniscus, the suturing procedure was not considered to have failed.

Table 2
Epidemiological characteristics of the two meniscal repair subgroups, with 5 years and 10 years of follow-up, respectively.

	5-year subgroup (%)	10-year subgroup (%)	*P*
Depth			
Zone 1	62.0	58.3	0.921
Zone 2	38.0	41.7	
Location			
Posterior	64.9	50.0	0.101
Posterior + middle	12.2	34.2	
Anterior	17.6	13.2	
Anterior + middle	1.4	2.6	
Middle	4.1	0.0	
Meniscus			
Medial	73.1	75.6	0.242
Lateral	24.4	19.5	
Both	2.6	4.9	

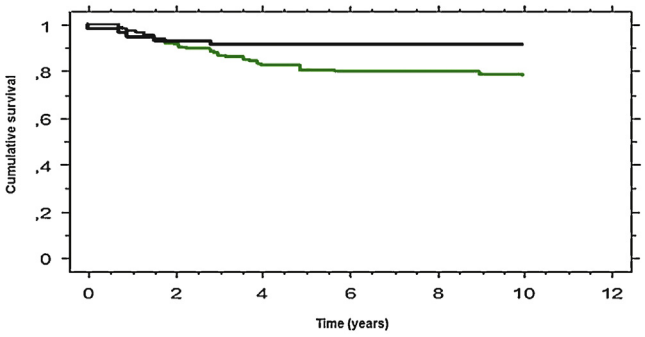

Fig. 1. Ten-year survival of healthy menisci (black line) compared to sutured menisci (green line) (time in years).

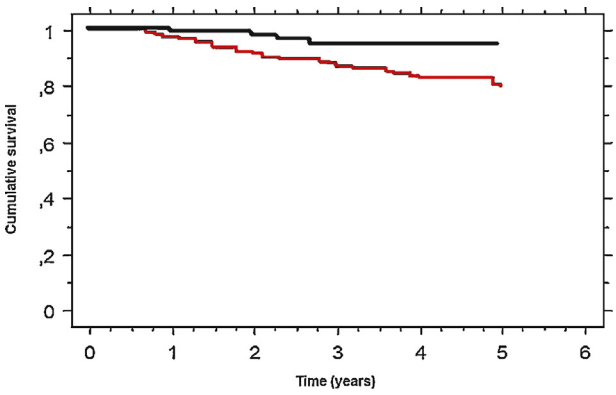

Fig. 2. Five-year survival of healthy menisci (black line) compared to sutured menisci (red line) (time in years).

2.1. Statistical analysis

Between-group comparisons of qualitative variables relied on either the Chi-square test or Fisher's exact test. Meniscal survival was assessed by plotting Kaplan-Meier survival curves, which were compared using the log-rank test. Values of $P \leq 0.05$ were considered significant. The statistical analyses were performed using Statview 5.0 and SAS 9.1.3 software (SAS Institute, Cary, NC, USA).

3. Results

A total of 235 ACL reconstruction procedures were included, 120 in the control group (no detected meniscal lesions), and 115 in the meniscal repair group with 76 followed-up for 5 years and 39 for 10 years. Mean age was 27.8 years (range: 20–61 years). The male-to-female ratio was 2/3. Mean time from injury to surgery was 36 ± 79 months.

In the meniscal repair group, 75% of patients had tears in the medial meniscus and 25% in the lateral meniscus. Vertical tears predominated (64% of cases). Zone I was involved in 57% and zone II in 38% of cases. All these variables were comparable across groups.

The post-operative difference in laxity compared to the contralateral knee was 1.59 mm (1–10 mm) in the 10-year and 2.86 mm (1–6 mm) in the 5-year meniscal repair subgroups and 1.69 mm (1–8 mm) in the control group. The differences were significant between the 5-year and 10-year meniscal repair subgroups ($P = 0.021$) and between the 5-year meniscal repair subgroup and the control group ($P = 0.008$).

Meniscal survival after 5 years was 95% in the control group and 80% in the meniscal repair group ($P = 0.00289$). After 10 years, meniscal survival was not significantly different between these two groups (88 and 77%, respectively; $P = 0.07$), but the samples were small. A detailed analysis of the 10-year survival curves showed an inflection after nearly identical follow-up times in the control group and meniscal repair subgroup. The change in the slope of the survival curve indicated that most of the meniscal lesions occurred within 4 years after ACL reconstruction (Figs. 1 and 2).

To determine whether meniscal survival differed between patients who had surgery in 2003 vs. 2008, we determined 5-year meniscal survival in the 10-year meniscal repair subgroup (surgery in 2003), which was 82%, compared to 78% in patients who underwent meniscal repair in 2008. The difference was not statistically significant ($P = 0.62$).

After 5 years, failure was far less common for the lateral meniscus (no events) than for the medial meniscus ($P = 0.008$). After 10 years, the difference was not significantly different ($P = 0.512$), although the number of failures remained lower for the lateral than for the medial meniscus (1 vs. 7, respectively).

Residual laxity was strongly associated with meniscal survival. Comparing the patients with side-to-side knee laxity differences of <4 mm vs. ≥4 mm showed failure rates of 86 and 56%, respectively (relative risk: 5; $P = 0.0054$). Less significant associations were noted for the other potential risk factors analysed in our study (e.g., body mass index, level of sporting activities, age, and gender).

4. Discussion

This retrospective multicentre study with a follow-up of 5 or 10 years showed that meniscal damage developed over time despite effective stabilisation of the knee. Thus, when no meniscal lesions were detected during ACL reconstruction, the meniscal survival rates were 95% after 5 years and 88% after 10 years. These data are consistent with earlier work such as the study by Westermann et al., which showed a 14% failure rate after 6 years [9]. Another finding from our study is that these meniscal lesions usually develop within the first 4 years after ACL reconstruction, in keeping with the results of the meta-analysis by Nepple et al. [10]. Sutured menisci had significantly lower survival rates after 5 years but not after 10 years, compared to controls. In the meniscal repair group also, the risk of new lesions was highest within 4 years after ACL reconstruction [5].

The 5-year failure rate was considerably lower for the lateral than for the medial meniscus, whereas no significant difference was noted after 10 years. In contrast, a strong association with residual laxity was demonstrated: a difference in laxity ≥4 mm versus the contralateral knee was associated with a 5-fold increase in the failure rate.

Our study shows that, despite ACL reconstruction, meniscal lesions can develop over time, in both healthy and sutured menisci. Several factors may explain this finding. First, meniscal lesions may have been missed at surgery in some of the controls, as reported by Sonnery-Cottet et al. [20]. Evaluation of the postero-medial segment by introducing the arthroscope into the notch under the posterior cruciate ligament can detect many medial meniscal lesions that are not visible during the standard anterior examination via an antero-lateral portal [9,20]. Thus, some meniscal lesions may go undiagnosed during the ACL reconstruction procedure. This hypothesis is consistent with our finding that most of the meniscal lesions developed within 4 years post-operatively.

The meniscal survival rate was not significantly different between control and sutured menisci after 10 years (whereas the difference was significant after 5 years). Thus, the occurrence of meniscal suture failure should be put into perspective. Some failures are probably ascribable to absence of tear healing and therefore occur within the first few years after ACL reconstruction. Others are likely to be related to underestimation of the initial damage, which is therefore inadequately stabilised [8,9]. Thus, there may be a turning point (at about 4 years) after which the kinematics

of the sutured meniscus may be similar to that of the normal meniscus, provided the ACL reconstruction procedure is effective.

ACL reconstruction provides overall control of knee instability. However, some degree of laxity may persist, resulting in the development of osteoarthritis in a clinically 'stable' knee with no initial meniscal damage. ACL reconstruction (regardless of the technique used) may fail to consistently provide full control of rotational laxity [11] and restoration of normal knee kinematics [12]. We found that the risk of new meniscal lesions was increased when the residual antero-posterior laxity was ≥4 mm. Imperfect ACL reconstruction is not the only cause of residual laxity. Thus, posterior segment meniscectomy increases laxity in the sagittal plane and induces deformation of the ligament graft [13]. Similarly, a postero-medial meniscal lesion that is missed during the initial surgical procedure increases the loads applied to the graft, thereby affecting tibio-femoral laxity and, in turn, worsening the meniscal lesion [14]. The other hypothesis involves inadequate initial control of antero-posterior and rotational laxity, which then causes new meniscal lesions. The effect of laxity on the menisci is further supported by the higher meniscal survival rate in stable than in stabilised knees [15].

Another hypothesis involves poorer muscle control. Studies show that the risk factors for osteoarthritis include a number of musculo-skeletal parameters, particularly a low hamstring-to-quadriceps ratio [16]. Finally, Narazaki et al. recently showed that, despite effective knee stabilisation, significant extrusion of the medial and lateral menisci developed within the first post-operative year, as well as antero-posterior elongation of the medial meniscus [17].

Despite the large sample size, our study has several limitations. The design was retrospective. The mean laxity difference after surgery was less than 4 mm, but this parameter differed between the 5-year and 10-year subgroups. Several different devices were used to measure laxity, according to standard practice in each centre, raising questions about the interpretation of the results. In addition, the number of patients followed-up for 10 years was small. This fact probably explains the non-significant difference in meniscal lesion recurrence between the medial and lateral menisci after 10 years, whereas the difference was statistically significant after 5 years. Nevertheless, the side involved was not a fully-fledged risk factor in all studies [18,19]. Finally, we did not match the controls to the meniscal repair patients on age, body weight, side involved, or laxity difference.

5. Conclusion

Our study demonstrated that meniscal lesions can develop over time despite effective knee stabilisation, whether the meniscus was repaired or considered normal during the ligament reconstruction procedure. The risk of symptomatic meniscal lesions developing after ligament reconstruction is highest within the first 4 post-operative years. After 5 years, the meniscal survival rate was significantly lower in the meniscal repair group than in the control group, probably as a result of technical errors or failed healing. These problems occur within the first 4 years and, after 10 years, meniscal survival is comparable between control and sutured menisci. The strongest risk factor for meniscal lesion recurrence is a ≥4 mm difference in laxity versus the contralateral knee. Thus, effective knee stabilisation is of the utmost importance, and any concomitant meniscal lesions must be repaired concomitantly. Therefore, a routine, painstaking, and complete examination of both menisci is essential.

Disclosure of interest

B. Sonnery-Cottet is a consultant with Arthrex. The other authors declare that they have no conflicts of interest concerning this article.

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